CSE 360: Computer Interfacing

Section: 2

Lab Report

Innovative Car Stationing Solutions

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Introduction

In contemporary society, parking has become a major problem, especially in densely populated cities. Finding a parking spot may be a frustrating and time-consuming ordeal that wastes your time and forces you to use more gas than is required. We have developed and deployed a basic car parking system based on Arduino technology in an effort to address this issue.

Two infrared (IR) sensors monitor the parking lot's entry and exit. The number of available parking spots can be monitored through a LCD display. When a vehicle approaches the barrier at the entrance or exit, the first IR sensor detects it and triggers an opening signal. Similar to how the first IR sensor opens the barrier when a car approaches the entrance or exit gate, the second IR sensor triggers the barrier to open when a car approaches the entrance/exit gate. The number of available parking spots and other data are displayed in real-time on an LCD screen. When a car triggers the first IR sensor it decreases the number of available parking spots. Similarly, when exiting if a car triggers the second IR sensor first then the number of available spots in incremented by one.

To further assist drivers, we have installed an Ultrasonic Sonar Sensor that features three lights (LEDs) and a buzzer at the back of the parking spots. The LED lights will begin to illuminate in a distance-measuring pattern once a parking spot has been selected for the vehicle. When the car reaches the end of the parking line the third LED will light up. If the car crosses the safety line, the buzzer will start beeping to let the driver know that the vehicle has passed the parking line.

Through this work, we have demonstrated that Arduino and sensors can be used to create a simple yet effective parking system. We anticipate that widespread implementation of this technology will lead to significant gains in both parking efficiency.

Application Area

Smart Parking Systems:

With more cars on the road and fewer spots to park in cities, smart parking systems have become increasingly popular in recent years. To alleviate traffic and improve parking conditions for vehicles, these systems make use of sensors and cutting-edge technology.

When it comes to improving parking efficiency and making life easier for drivers, our straightforward Arduino-based technology is a game-changer. This system is adaptable for use in a wide range of high-traffic places, including retail centers, airports, neighborhoods, healthcare facilities, and corporate headquarters. Parking lots can be better managed with the use of infrared and ultrasonic sonar sensors that properly detect vehicle entry and exit. Upon entering a car, the LCD display will output and increment the number of vehicles. When a car leaves a parking spot, the total falls. Using our parking system, we can park the vehicles in a secure area. At the very end of the parking queue, three LED lights will be installed. Each LED will turn on when the car nears the end of the parking area. The vehicle is in a secure location when the third LED turns on. We've also built in a buzzer to alert the driver if his or her car goes beyond the designated stopping area. Vehicles can be parked securely in the lot using our system. If our technology is able to be combined with mobile apps, it will greatly improve the parking experience for all users, reducing traffic congestion, shortening the time spent looking for parking, and increasing parking space utilization.

In conclusion, the potential for our unique Arduino-based solution to be used in the context of smart parking systems is enormous. It's meant to revolutionize parking by offering a quick, easy, and cheap solution to the issue, which is good for motorists and parking lot owners alike.

Technology and Tools

We constructed our project with the help of an Arduino board and some other inexpensive electronic parts. Due to the straightforward nature of this parking lot construction, we made do with the following equipment and technologies:

1. **The Arduino board:** It functions as the project's microcontroller.
2. **IR Proximity sensors**: They take a reading of how far away the vehicle is from the sensors. When the car is detected by the IR sensors as an obstruction, the bar is either opened or closed.
3. **Ultrasonic Sonar sensor**: It is additionally set for use for pinpoint proximity detection. An ultrasonic module with a detecton range of 2cm-700cm; signals detected are stable within 5m, grow weaker beyond 5m and at last disappear
4. **LED lights**: They detect how far away a car is from the end of a parking space and illuminate as the driver approaches that end. The third light will turn on to let the driver know they have reached the end of the parking line.
5. **Buzzer:** It will activate if a car drives past the end of the parking queue. This will alert the driver that they have gone beyond the designated area.
6. **Breadboard**: It is used for connecting all of the components together.
7. **Jumper wires:** They were implemented for linking all of the different components. The connections were made using male-to-female and male-to-male jumper wires.
8. **An LCD display:** This display was used to display the details and provide information on the parking. For example, it can show "Slots left: 4".
9. **Servo Motor:** Using a signal from an Arduino, it can move the barrier that regulates access to and exit from the parking lot.

To write and compile code that can then be uploaded to the Arduino board, the Arduino Integrated Development Environment (IDE) has been used. The Arduino IDE is free, open-source software that features a basic code editor and can be used with a wide variety of Arduino libraries.

Programming Language

Arduino has its own programming language, which is a simplified version of C or C++ and is useful for newcomers working with Arduino boards. To work with this language, the Arduino

IDE is utilized, which aids in the programming of Arduino boards by providing many libraries and a simple code editor. The code for this project is built to operate and adjust the sensors and other components, as well as organize the project according to the project's design and requirements.

Working mechanisms of sensors

We employed the IR proximity sensor and the Ultrasonic sonar sensor in this car parking system. Both sensors are critical to the overall system's development since they make it simple to track calculations and correctness.

IR Proximity Sensor

The proximity IR sensor emits infrared light to recognize certain components in its surroundings. It can identify any barriers in front of the sensor and keep an eye out for movement and heat from the object. These sensors are classified as passive IR sensors since they do not emit IR radiation.

The proximity sensor, which is affixed to the parking lot ceiling, is made up of an infrared transmitter and a receiver. The IR emitter emits infrared photons, which typically bounce off surfaces.. The infrared sensor detects these rays, which are transformed into an electrical signal and a potential difference by the receiver.

If a car enters the parking space, the IR sensor will record it. As a result, when a new car arrives at the parking space, our system will notify the vehicle if there is a parking space available. Similarly, when a car departs a parking place, the IR records it and later assigns a free space to any vehicle that arrives for parking.

Ultrasonic Sonar Sensor

An ultrasonic sonar sensor is a type of sensor that is used to accurately measure distance. It employs a 40 kHz ultrasonic pulse that travels through the air and returns to the sensor if it comes into contact with a barrier or item. The travel time and sound speed can be used to calculate the distance.

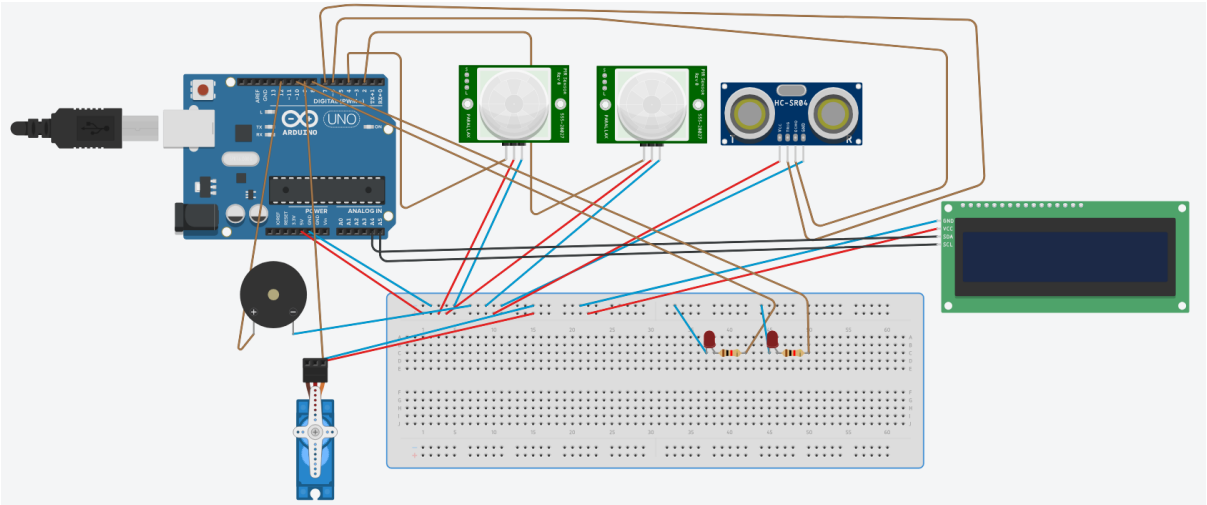
This sensor's use is critical for the car parking system. Accidents may occur if the correct distance is not known, and it may be difficult to identify the barriers that may cause accidents. As a result, this sensor, which is a combination of sonar, radar, and sound navigation, has been utilised to identify objects, including cables, up to a distance of 2.5 m. The sonar sends out short bursts of ultrasonic waves, calculating the time it takes for the waves to reach and bounce off an object to calculate its distance. When the sensor detects an object, it emits a beep. When the beeps get more rapid, the car is approaching the obstruction. Drivers can view the object on a screen if it is linked to cameras.

Connection with IC's

IC's has been used in this car parking system project because they can keep the vehicle from bumping into walls. It can also help reduce damages in the event of unavoidable collisions. The 8051 microcontrollers are linked to the IR receivers. Whenever a car enters the parking area it will block IR radiation. As a result, number of parking slots can be calculated.

The VCC and GND pins of the PIR sensor, Ultrasound Sonic sensor, servo motor, LCD are connected to the VCC and GND pins of the Arduino Board. The Negative end of the LEDs and Buzzer is also connected to the GND pin of the Arduino Board. The signal pin of the two PIR sensors is connected to the 2 and 4 pins of the Arduino Board. The Trigger pin and the echo pin of the Ultrasound sensor is connected to the 6 and 7 pin respectively. The signal pin of the servo motor is connected to the 9th pin of the Arduino Board. The positive end of the buzzer and LEDs is connected to 8, 10 and 14th pin of the Arduino Board. The SDA and SCL board of the I2C module connected to LCD screen was connected to A4 and A5 pin of the board.

Pin Diagram



Data flow from the sensor through IC's to I/O devices

Object identification and precise distance measuring are two uses for our system. Here, the infrared proximity sensor will spot the target, and the ultrasonic sonar sensor will get a precise read on how far away it is. Both infrared and ultrasonic sonar sensors will be active at the same time in our system.

The sonar sensor communicates with the Arduino whenever a car approaches the designated parking space, and the microcontroller calculates the distance between the car and the barrier based on the elapsed time and the speed of sound. Because of this, an LED will begin glowing. The servo barrier will automatically open as soon as the first IR sensor detects the car approaching. This means the vehicle will drive into the parking area. Once the second IR sensor determines that a car has entered the parking lot, the barrier will automatically shut. In addition, after driving a predetermined distance inside the parking lot, the sonar sensor will recalculate how far away the car is from the barrier. Moreover, if there is still a free parking spot in the lot, an LCD coupled to sensors and Arduino will display a message informing the driver. If there is no available parking spot, a notification will also be shown.

With the aid of an Ultrasonic sensor, a buzzer, and three LED lights, an automobile may park securely after pulling into a parking spot. The Ultrasonic sensor determines how far away the vehicle is and activates the LED lights as it gets closer to the end of the parking queue. Once

a car approaches the end of the parking queue, the third indicator light will come on. The Ultrasonic sensor will detect when the vehicle goes beyond the designated area, and the alarm will sound.

After the sonar sensor calculates the vehicle's distance, the second IR sensor lights up when an approaching vehicle is within range, and the barrier opens for the vehicle to pass through. Once a vehicle has left the parking lot, the first IR sensor will pick it up and the barrier will automatically shut. In this way, the system works.

Estimated Cost Analysis

Product	Quantity	Unit price	Total price
Ultrasonic Sonar Sensor HC- SR04	**1**	BDT 90	BDT 90
Breadboard (Medium Size)	**1**	BDT 75	BDT 75
IR Infrared Obstacle Avoidance Sensor Module	**2**	BDT 70	BDT 140
MG996R 10kg Servo (Fully Metal)	**1**	BDT 445	BDT 445
16x2 Serial LCD Module Display for Arduino Assembled	**1**	BDT 385	BDT 385
Jumper Wire 40 Pcs Set - Jumper Wire Type: Male to Female	**1**	BDT 100	BDT 100
RGB 2 Pin LED 5mm (pack of 5)	**1**	BDT 10	BDT 10
Arduino Uno R3	**1**	BDT 1,100	BDT 1,100

Active Buzzer Module	**1**	BDT 50	BDT 50
Subtotal			**BDT 2,410**

Here, the overall cost of our project is very low considering its multiple purposes. Implementation on a larger scale will cost higher than our project but it will not cost much in general.

Responsibilities of Each Member

Member Name	Assigned Task
Naimur Rahman (20101284)	● Introduction. ● Parts Acquirement ● Working mechanisms of sensors ● Reference.
Ha-mim Ahmad (20101286)	● Research. ● Application Area. ● Connection with IC's. ● Technology & tools.
Rakinul Haque(20101290)	● Research. ● Connection with ICs. ● Data flow from sensors through IC's to I/O devices. ● Coding.
Nowreen Tarannum Rafa(20101329)	● Research about sensors. ● Pin diagram. ● Future plan. ● Coding.

Kazi Nazibul Islam(20101372)	• Research about sensors • Connection with IC's. • Cost analysis. • Conclusion

Conclusion

In conclusion, the Arduino-based car parking project has proven to be an efficient and effective solution to the growing problem of parking in urban areas. The project successfully utilized Arduino technology to create a smart parking system that not only helps drivers locate available parking slots but also helps efficient use of lighting.

Through the implementation of various sensors and components, the Arduino-based car parking system has demonstrated accuracy and reliability in detecting vehicle presence and occupancy through a user-friendly interface.

Overall, the Arduino-based car parking project has provided a cost-effective and sustainable solution to the issue of parking in urban areas. It has demonstrated the potential of utilizing technology to address common urban challenges and improve the quality of life for city dwellers.

Future Plan

We have some future plans for our Arduino-powered auto parking system. Our future strategy could center on sensor advancements and energy efficiency. We could also look into renewable energy sources. An innovative feature may be integration with a simple mobile app to verify spot availability. Plus we will try to take the feature of the buzzer and integrate it into our app. This way, the drivers can be alerted through their app whether they have parked their cars perfectly or not. Scaling is important as we want to have parking on more

than one level or connect several lots. License plate recognition and predictive analytics could be ambitious features to our project that would be helpful. Collaboration with local governments and business groups, keeping safety measures in place, and handling things like EV charging that help the environment could all be important. A key part of the project's ongoing growth will be the continuous monitoring of iterative changes.

Reference

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